

I CLAIM:

1. In a photoelectrochemical cell having at least one semiconductor photoelectrode, a second electrode and an electrolytic solution disposed therebetween, the improvement comprising:

5 a housing enclosing said photoelectrochemical cell, said housing comprising at least one light transmissive wall, said light transmissive wall and said at least one semiconductor photoelectrode forming a space therebetween, said space containing substantially no said electrolytic solution;

10 said at least one semiconductor photoelectrode comprising a proton exchange membrane having an electrolyte facing surface in contact with said electrolytic solution and a light transmissive wall facing surface; and

a photo electro-catalyst disposed on said light transmissive wall facing surface.

15 2. A photoelectrochemical cell in accordance with Claim 1, wherein said second electrode is a semiconductor photoelectrode.

20 3. A photoelectrochemical cell in accordance with Claim 2, wherein each of said semiconductor photoelectrodes comprises at least one wide band gap semiconductor.

4. A photoelectrochemical cell in accordance with Claim 3, wherein said at least one wide band gap semiconductor is a p-type semiconductor comprising TiO_2 .

5. A photoelectrochemical cell in accordance with Claim 3, wherein said at least one wide band gap semiconductor is an n-type semiconductor comprising TiO_2 .

6. A photoelectrochemical cell in accordance with Claim 3, wherein said at least one wide band gap semiconductor comprises carbon black.

7. A photoelectrochemical cell in accordance with Claim 6, wherein said at least one wide band gap semiconductor comprises a Nafion emulsion binder.

8. A photoelectrochemical cell in accordance with Claim 3, wherein said at least one wide band gap semiconductor comprises at least one electrically conductive polymer.

9. A photoelectrochemical cell in accordance with Claim 8, wherein said at least one electrically conductive polymer is selected from the group consisting of polyaniline, polypyrrole and combinations thereof.

10. A photoelectrochemical cell in accordance with Claim 8, wherein
said at least one electrically conductive polymer is at least partially sulfonated.

11. A photoelectrochemical cell in accordance with Claim 3, wherein
said at least one wide band gap semiconductor comprises one of an electron
conductive polymer and a proton conductive polymer.

12. A photoelectrochemical cell in accordance with Claim 1, wherein
said light transmissive wall is made of a material selected from the group consisting
of glass and plexiglas.

13. A photoelectrochemical cell in accordance with Claim 1 further
comprising a metallic connector suitable for connecting said photoelectrochemical
cell to another photoelectrochemical cell.

14. A photoelectrochemical cell comprising:
a light transmissive enclosure;
a semiconductor photoanode disposed within said light transmissive
enclosure;
a semiconductor photocathode disposed within said light transmissive
enclosure; and

an electrolytic solution disposed entirely between said semiconductor photoanode and said semiconductor photocathode.

5 15. A photoelectrochemical cell in accordance with Claim 14, wherein each of said semiconductor photoanode and said semiconductor photocathode comprises a proton exchange membrane having an electrolytic solution facing surface in contact with said electrolytic solution and a light transmissive enclosure facing surface, and a semiconductor layer disposed on said light transmissive enclosure facing surface.

10 16. A photoelectrochemical cell in accordance with Claim 15, wherein said semiconductor layer comprises at least one wide band gap semiconductor.

15 17. A photoelectrochemical cell in accordance with Claim 16, wherein said at least one wide band gap semiconductor is a p-type semiconductor.

18. A photoelectrochemical cell in accordance with Claim 16, wherein said at least one wide band gap semiconductor is an n-type semiconductor.

20 19. A photoelectrochemical cell in accordance with Claim 16,

wherein said at least one wide band gap semiconductor comprises carbon black.

20. A photoelectrochemical cell in accordance with Claim 19,
wherein said at least one wide band gap semiconductor comprises a Nafion emulsion
5 binder.

21. A photoelectrochemical cell in accordance with Claim 16,
wherein said at least one wide band gap semiconductor comprises at least one
electrically conductive polymer.

22. A photoelectrochemical cell in accordance with Claim 21,
wherein said at least one electrically conductive polymer is selected from the group
consisting of polyaniline, polypyrrole and combinations thereof.

23. A photoelectrochemical cell in accordance with Claim 21,
wherein said at least one electrically conductive polymer is at least partially
sulfonated.

24. A photoelectrochemical cell in accordance with Claim 16,
wherein said at least one wide band gap semiconductor comprises one of an electron
20 conductive polymer and a proton conductive polymer.

25. A photoelectrochemical cell in accordance with Claim 15, wherein said light transmissive wall is made of a material selected from the group consisting of glass and plexiglas.

5 26. A photoelectrochemical cell in accordance with Claim 15 further comprising a metallic connector suitable for connecting said photoelectrochemical cell to another photoelectrochemical cell.